

King's Research Portal

DOI:

[10.1111/gcb.13516](https://doi.org/10.1111/gcb.13516)

[10.1111/gcb.13516](https://doi.org/10.1111/gcb.13516)

Document Version

Publisher's PDF, also known as Version of record

[Link to publication record in King's Research Portal](#)

Citation for published version (APA):

Wijedasa, L. S., Jauhiainen, J., Könönen, M., Lampela, M., Vasander, H., Leblanc, M-C., Evers, S., Smith, T., Yule, C. M., Varkkey, H., Lupascu, M., Parish, F., Singleton, I., Clements, G. R., Aziz, S. A., Harrison, M. E., Cheyne, S., Anshari, G. Z., Meijaard, E., ... Andersen, R. (2017). Denial of long-term issues with agriculture on tropical peatlands will have devastating consequences. *GLOBAL CHANGE BIOLOGY*, 23(3), 977-982.
<https://doi.org/10.1111/gcb.13516>, <https://doi.org/10.1111/gcb.13516>

Citing this paper

Please note that where the full-text provided on King's Research Portal is the Author Accepted Manuscript or Post-Print version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version for pagination, volume/issue, and date of publication details. And where the final published version is provided on the Research Portal, if citing you are again advised to check the publisher's website for any subsequent corrections.

General rights

Copyright and moral rights for the publications made accessible in the Research Portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognize and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the Research Portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the Research Portal

Take down policy

If you believe that this document breaches copyright please contact librarypure@kcl.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.

LETTER TO THE EDITOR

Denial of long-term issues with agriculture on tropical peatlands will have devastating consequences

LAHIRU S. WIJEDASA^{1,2,3,*}, JYRKI JAUHIAINEN⁴, MARI KÖNÖNEN⁴, MAIJA LAMPELA⁴, HARRI VASANDER⁴, MARIE-CLAIRE LEBLANC⁵, STEPHANIE EVERS^{6,7,8}, THOMAS E. L. SMITH⁹, CATHERINE M. YULE^{7,10}, HELENA VARKKEY^{7,11}, MASSIMO LUPASCU¹², FAIZAL PARISH¹³, IAN SINGLETON¹⁴, GOPALASAMY R. CLEMENTS^{3,6,10,15,16}, SHEEMA ABDUL AZIZ^{3,6,16}, MARK E. HARRISON^{17,18}, SUSAN CHEYNE¹⁷, GUSTI Z. ANSHARI¹⁹, ERIK MEIJAARD^{20,21}, JENNY E. GOLDSTEIN²², SUSAN WALDRON²³, KRISTELL HERGOUALC'H²⁴, RENE DOMMAIN²⁵, STEVE FROLKING²⁶, CHRISTOPHER D. EVANS²⁷, MARY ROSE C. POSA¹, PAUL H. GLASER²⁸, NYOMAN SURYADIPUTRA²⁹, REZA LUBIS²⁹, TRULY SANTIKA²¹, RORY PADFIELD^{7,30,31}, SOFYAN KURNIANTO^{24,32}, PANUT HADISISWOYO³³, TECK WYN LIM³⁴, SUSAN E. PAGE¹⁸, VINCENT GAUCI³⁵, PETER J. VAN DER MEER³⁶, HELEN BUCKLAND³⁷, FABIEN GARNIER³⁷, MARSHALL K. SAMUEL^{6,7,38,39}, LIZA NURIATI LIM KIM CHOO³⁸, PATRICK O'REILLY^{7,40,41}, MATTHEW WARREN⁴², SURIN SUKSUWAN⁴³, ELHAM SUMARGA⁴⁴, ANUJ JAIN^{2,45}, WILLIAM F. LAURANCE⁴⁶, JOHN COUWENBERG⁴⁷, HANS JOOSTEN⁴⁷, RONALD VERNIMMEN⁴⁸, ALJOSJA HOOIJER⁴⁸, CHRIS MALINS⁴⁹, MARK A. COCHRANE⁵⁰, BALU PERUMAL⁵¹, FLORIAN SIEGERT^{52,53}, KELVIN S.-H. PEH^{54,55}, LOUIS-PIERRE COMEAU⁵⁶, LOUIS VERCHOT⁵⁷, CHARLES F. HARVEY^{58,59}, ALEX COBB⁵⁹, ZEEHAN JAAFAR^{1,60}, HENK WÖSTEN⁶¹, SOLICHIN MANURI⁶², MORITZ MÜLLER⁶³, WIM GIESEN⁶⁴, JACOB PHELPS⁶⁵, DING LI YONG^{6,3,66}, MARCEL SILVIUS⁶⁷, BÉATRICE M. M. WEDEUX⁶⁸, ALISON HOYT^{58,59}, MITSURU OSAKI⁶⁹, TAKASHI HIRANO⁶⁹, HIDENORI TAKAHASHI⁷⁰, TAKASHI S. KOHYAMA⁶⁹, AKIRA HARAGUCHI⁷¹, NUNUNG P. NUGROHO⁷², DAVID A. COOMES⁶⁸, LE PHAT QUOI⁷³, ALUE DOHONG⁷⁴, HARIS GUNAWAN⁷⁴, DAVID L. A. GAVEAU²⁴, ANDREAS LANGNER⁷⁵, FELIX K. S. LIM⁷⁶, DAVID P. EDWARDS⁷⁶, XINGLI GIAM⁷⁷, GUIDO VAN DER WERF⁷⁸, RACHEL CARMEN TA²⁴, CASPAR C. VERWER⁷⁹, LUKE GIBSON⁸⁰, LAURE GANDOIS⁸¹, LAURA LINDA BOZENA GRAHAM⁸², JHANSON REGALINO⁸², SERGE A. WICH^{8,83}, JACK RIELEY⁸⁴, NICHOLAS KETTRIDGE⁸⁵, CHLOE BROWN⁸⁴, ROMAIN PIRARD²⁴, SAM MOORE⁸⁶, B. RIPOLL CAPILLA¹⁷, UWE BALLHORN⁵³, HUA CHEW HO⁸⁷, AGATA HOSCILO⁸⁸, SANDRA LOHBERGER⁵³, THEODORE A. EVANS⁸⁹, NINA YULIANTI⁹⁰, GRACE BLACKHAM⁹¹, ONRIZAL⁹², SIMON HUSSON¹⁷, DANIEL MURDIYARSO^{24,93}, SUNITA PANGALA³⁵, LYDIA E. S. COLE⁹⁴, LUCA TACCONI⁹⁵, HENDRIK SEGAI⁹¹, PRAYOTO TONOTO⁹⁶, JANICE S. H. LEE⁹⁷, GERALD SCHMILEWSKI⁹⁸, STEPHAN WULFFRAAT⁹⁹, ERIANTO INDRA PUTRA^{2,5,100}, MEGAN E. CATTAN¹⁰¹, R. S. CLYMO¹⁰², ROSS MORRISON¹⁰³, AAZANI MUJAHID¹⁰⁴, JUKKA MIETTINEN¹⁰⁵, SOO CHIN LIEW¹⁰⁵, SAMU VALPOLA¹⁰⁶, DAVID WILSON¹⁰⁷, LAURA D'ARCY¹⁷, MICHIEL GERDING⁹⁸, SITI SUNDARI¹⁰⁸, SARA A. THORNTON^{17,18}, BARBARA KALISZ¹⁰⁹, STEPHEN J. CHAPMAN¹¹⁰, AHMAD SUHAIZI MAT SU¹¹¹, IMAM BASUKI^{24,32}, MASAYUKI ITOH¹¹², CARL TRAEHOLT¹¹³, SEAN SLOAN⁴⁶, ALEXANDER K. SAYOK¹¹⁴ and ROXANE ANDERSEN^{115,*}

¹Department of Biological Sciences, National University of Singapore, 14 Science Drive 4, 117543, Singapore, ²ConservationLinks, 433 Clementi Avenue 3, #01-258, 120433, Singapore, ³Rimba, Malaysia, Jalan 1/9D, Bandar Baru Bangi, Selangor, MY 43650, Malaysia, ⁴University of Helsinki, P.O. Box 3 (Fabianinkatu 33), 00014 Helsinki, Finland, ⁵Faculté des Sciences de l'Agriculture et de l'Alimentation, 2425, Rue de l'agriculture, Pavillon Paul-Comtois, Bureau 1122, Ville de Québec, QC G1V 0A6, Canada, ⁶School of Biosciences, University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Selangor Darhul Ehsan, Malaysia, ⁷Tropical Catchment Research Initiative (TROCARI), Kuala Lumpur, Malaysia, ⁸School of Natural Sciences &

Correspondence: Lahiru Wijedasa & Roxane Andersen, tel. +65-90667160, fax +65-67792486, e-mails: lahirux@gmail.com, Roxane.Andersen@uhi.ac.uk

Psychology, Liverpool John Moores University, Byrom Street, Liverpool L33AF, UK, ⁹School of Geography, King's College London, London WC2R 2NA, UK, ¹⁰Monash University Malaysia, Jalan Lagoon Selatan, Bandar Sunway, 47500 Subang Jaya, Selangor, Malaysia, ¹¹Department of International & Strategic Studies and Asia-Europe Institute, University of Malaya, 50603 Kuala Lumpur, Malaysia, ¹²Department of Geography, National University of Singapore, AS2, #03-01, 1 Arts Link, Kent Ridge, 117570, Singapore, ¹³Global Environment Centre, 2nd Floor, Wisma Hing, 78, Jalan SS2/72, Petaling Jaya, Selangor 47300, Malaysia, ¹⁴Sumatran Orangutan Conservation Programme, Jl. Wahid Hasyim No. 51/74 Medan, 20154 Sumatera Utara – Indonesia, ¹⁵Kenyir Research Institute, Universiti Malaysia Terengganu, T145, 21300 Kuala Terengganu, Malaysia, ¹⁶Departement d'Écologie et Gestion de la Biodiversité, Muséum National d'Histoire Naturelle, UMR 7179/CNRS-MNHN, 1 Avenue du Petit Chateau, 91800 Brunoy, France, ¹⁷Borneo Nature Foundation, Jalan Bukit Raya No. 82 Bukit Raya Palangka Raya, 73112 Central Kalimantan, Indonesia, ¹⁸University of Leicester, University Rd, Leicester LE1 7RH, UK, ¹⁹Centre for Wetlands, People and Biodiversity, Tanjungpura University, Pontianak Tenggara, Barat, 78124 Western Kalimantan, Indonesia, ²⁰Borneo Futures, Country Woods 306, Jalan WR Supratman, Pondok Ranji-Rengas, Ciputat, 15412 Tangerang, Indonesia, ²¹School of Biological Sciences, University of Queensland, Brisbane, QLD 4072, Australia, ²²Cornell University, Ithaca, NY 14850, USA, ²³School of Geographical and Earth Sciences, University of Glasgow, R517B Level 5 GES, East Quadrangle, Main Building, Glasgow G12 8QQ, UK, ²⁴Center for International Forestry Research (CIFOR), P.O. Box 0113 BOCBD, Bogor 16000, Indonesia, ²⁵Human Origins Program, National Museum of Natural History, Smithsonian Institution, 10th St. & Constitution Ave. NW, Washington, D.C. 20560, USA, ²⁶Institute for the Study of Earth, Oceans and Space, University of New Hampshire, Durham, NH 03824, USA, ²⁷Centre for Ecology and Hydrology, Environment Centre, Deiniol Rd, Bangor LL57, UK, ²⁸Department of Earth Sciences, University of Minnesota, 310 Pillsbury Drive SE, Minneapolis, MN 55455-0231, USA, ²⁹Wetlands International Indonesia Programme, Jl. Bango No. 11, Bogor 16161, Indonesia, ³⁰Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia, Jalan Sultan Yahya Petra, 54100 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia, ³¹Department of Social Sciences, Oxford Brookes University, Headington Campus, Oxford OX3 0BP, UK, ³²Department of Fisheries and Wildlife, Oregon State University, Nash Hall, 2820 SW Campus Way, Corvallis, OR 97331, USA, ³³Orangutan Information Centre, Jl. Sembada XVI, Jl. Bunga Sedap Malam XVIII C No. 10 20131. Kecamatan Medan Selayang Medan, Sumatera Utara 20131, Indonesia, ³⁴Resource Stewardship Consultants Sdn Bhd, Jalan Othman, Petaling Jaya, Malaysia, ³⁵School of Environment, Earth and Ecosystem Sciences, The Open University, Walton Hall Milton Keynes MK7 6AA, UK, ³⁶Van Hall Larenstein, University of Applied Sciences, Agora 1, PO Box 1528, 8901 BV Leeuwarden, The Netherlands, ³⁷Sumatran Orangutan Society, London, 7 Stert Street, Abingdon, Oxfordshire OX14 3JF, UK, ³⁸Climate Change Programme, Malaysian Agricultural Research and Development Institute (MARDI), P.O. Box 59, Roban, 95300 Saratok, Sarawak, Malaysia, ³⁹Global Research Alliance (GRA), USDA-FAS, Washington State University, 1400 Independence Avenue, SW Mail Stop 1001, Washington, D.C. 20250, USA, ⁴⁰Crops for the Future, Jalan Broga, 43500 Semenyih, Selangor Darul Ehsan, Malaysia, ⁴¹School of Politics, History and International Relations, University of Nottingham Malaysia Campus, Jalan Broga, 43500 Semenyih, Selangor Darul Ehsan, Malaysia, ⁴²USDA Forest Service, Northern Research Station, 410 MacInnes Drive, Houghton, MI 49931-1199, USA, ⁴³Proforest, Suite #303, MBE Desa Sri Hartamas No. 30G, Jalan 25/70 A, 50480, Kuala Lumpur, Malaysia, ⁴⁴School of Life Sciences and Technology, Institut Teknologi Bandung, Jl. Ganesa 10, Cobleng, Kota Bandung, Jawa Barat 40132, Indonesia, ⁴⁵BirdLife International, The David Attenborough Building, 1st Floor, Pembroke Street, Cambridge CB2 3QZ, UK, ⁴⁶Centre for Tropical Environmental and Sustainability Science (TESS) & College of Science and Engineering, James Cook University, PO Box 6811, Cairns, Queensland 4870, Australia, ⁴⁷Partner in the Greifswald Mire Centre, Ernst Moritz Arndt University of Greifswald, c/o Michael Succow Stiftung, Ellernholzstr. 1/3, 17489 Greifswald, Germany, ⁴⁸Deltares, Boussinesqweg 1, 2629 HV Delft, Netherlands, ⁴⁹Cerulogy, The International Council on Clean Transportation, 11 Belgrave Road, London SW1V 1RB, UK, ⁵⁰Geospatial Sciences Center of Excellence, South Dakota State University, 1021 Medary Ave, Wecota Hall 115 Box 506B, Brookings, SD 57007, USA, ⁵¹Malaysian Nature Society, JKR 641 Jalan Kelantan, Bukit Persekutuan, Kuala Lumpur 50480, Malaysia, ⁵²GeoBio Center, Ludwig-Maximilians-University, Richard-Wagner-Str. 10, 80333 München, Germany, ⁵³RSS Remote Sensing Solutions GmbH, Isarstraße 3, 82065 Baierbrunn, Germany, ⁵⁴Centre for Biological Sciences, University of Southampton, University Road, Southampton SO17 1BJ, UK, ⁵⁵Conservation Science Group, Department of Zoology, University of Cambridge, Downing St, Cambridge CB2 3EJ, UK, ⁵⁶Department of Geography and Resource Management, The Chinese University of Hong Kong, 2nd Floor, Wong Foo Yuan Building, Shatin, N.T., Hong Kong, ⁵⁷International Centre for Tropical Agriculture (CIAT), Km 17 Recta Cali-Palmira, Apartado Aéreo 6713, 763537 Cali, Colombia, ⁵⁸Singapore-MIT Alliance for Research and Technology, 1 CREATE Way, #10-01 CREATE Tower, 138602, Singapore, ⁵⁹Parsons Laboratory, Massachusetts Institute of Technology, Cambridge, 77 Massachusetts Ave 48, Cambridge, MA 02139, USA, ⁶⁰Department of Vertebrate Zoology, National Museum of Natural History, Smithsonian Institution, PO Box 37012 SI Building, Room 153, MRC 010, Washington, D.C. 20013-7012, USA, ⁶¹Wageningen University and Research, 6708 PB Wageningen, The Netherlands, ⁶²Fenner School of Environment and Society, Australian National University, Linnaeus Way, Acton, ACT 2601, Australia, ⁶³Swinburne University of Technology Sarawak Campus, Jalan Simpang Tiga, 93300 Kuching, Sarawak, Malaysia, ⁶⁴Euroconsult Mott MacDonald,

Amsterdamseweg 15, 6814 CM Arnhem, The Netherlands,⁶⁵Lancaster Environment Centre, Library Avenue, Lancaster University, Lancaster LA1 4YQ, UK, ⁶⁶Southeast Asian Biodiversity Society, Raffles Museum of Biodiversity Research, Faculty of Science, The National University of Singapore, Block S6, Level 3, Science Drive 2, 117600, Singapore, ⁶⁷Wetlands International, P.O. Box 471, 6700 AL Wageningen, The Netherlands, ⁶⁸Department of Plant Sciences, University of Cambridge, Downing St, Cambridge CB2 3EA, UK, ⁶⁹Hokkaido University, 5 Chome Kita 8 Jonishi, Kita Ward, Sapporo, Hokkaido Prefecture 060-0808, Japan, ⁷⁰NPO Hokkaido Institute of Hydro-Climat, Frontier 14, N 14 W 3, Kita-ku, Sapporo 001-0014, Japan, ⁷¹Kyushu Institute of Technology, 1-1 Sensui-cho, Tobata-ku, Kitakyushu-shi, Fukuoka 804-8550, Japan, ⁷²Research and Development Institute on Watershed Management Technology, Research, Development and Innovation Agency, Ministry of Environment and Forestry, Wanabakti Block I 2nd Floor Jalan Jenderal Gatot Subroto Jakarta Pusat, 10270 Jakarta, Indonesia, ⁷³Institute for Environment and Natural Resources, National University at HCM City, 6 Quarter, Linh Trung Ward, Thu Duc District, Ho Chi Minh City, Vietnam, ⁷⁴Peatland Restoration Agency (BRG), UNPAR, Jakarta LP3LH, Indonesia, ⁷⁵Joint Research Centre of the European Commission, Directorate D – Sustainable Resources – Bio-Economy Unit, Via E. Fermi, 2749, I-21027 Ispra (VA), Italy, ⁷⁶Department of Animal and Plant Sciences, University of Sheffield, Western Bank, Sheffield S10 2TN, UK, ⁷⁷School of Aquatic and Fishery Sciences, University of Washington, 1122 NE Boat St, Seattle, WA 98105, USA, ⁷⁸Faculty of Earth and Life Sciences, University Amsterdam, De Boelelaan 1085-1087, 1081 HV Amsterdam, The Netherlands, ⁷⁹International Union for Conservation of Nature (IUCN), National Committee of The Netherlands, Plantage Middenlaan 2K, 1018 DD Amsterdam, The Netherlands, ⁸⁰School of Biological Sciences, Kadoorie Biological Sciences Building, The University of Hong Kong, Pok Fu Lam Road, Hong Kong SAR, China, ⁸¹Laboratoire Ecologie Fonctionnelle et Environnement, Université de Toulouse, CNRS, INPT, UPS, 18, Route de Narbonne Bât. 4R1, 31062 Toulouse Cedex 9, France, ⁸²Borneo Orangutan Survival Foundation (BOSF), Jalan Papandayan No. 10, Bogor 16151, Indonesia, ⁸³Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, P.O. Box 94248, 1090 GE Amsterdam, The Netherlands, ⁸⁴School of Geography, University of Nottingham, University Park, Nottingham NG7 2RD, UK, ⁸⁵School of Geography, Earth and Environmental Science, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK, ⁸⁶Environmental Change Institute, School of Geography and the Environment, University of Oxford, South Parks Road, Oxford OX1 3QY, UK, ⁸⁷Nature Society (Singapore), 510 Geylang Road, #02-05, The Sunflower, 389466, Singapore, ⁸⁸Remote Sensing Centre, Institute of Geodesy and Cartography, ul. Modzelewskiego 27, 02-679 Warsaw, Poland, ⁸⁹School of Animal Biology, University of Western Australia, 35 Stirling Highway, Crawley, Perth, WA 6009, Australia, ⁹⁰University of Palangka Raya, Palangkaraya, 73112 Central Kalimantan, Indonesia, ⁹¹Wildfowl and Wetlands Trust, Queen Elizabeth's Walk, London SW13 9WT, UK, ⁹²Tropical Forest Ecology and Conservation Division, Faculty of Forestry, Universitas Sumatera Utara, Jl. Dr. Mansur No. 9B, Kampus USU, Padang Bulan, Kota Medan, Sumatera Utara 20155, Indonesia, ⁹³Department of Geophysics and Meteorology, Bogor Agricultural University, Jln. Meranti, Kampus IPB Darmaga, Bogor 16680, Indonesia, ⁹⁴Department of Global Change Biology Zoology, Oxford Long-term Ecology Laboratory, University of Oxford, The Tinbergen Building, South Parks Road, Oxford OX1 3PS, UK, ⁹⁵Crawford School of Public Policy, The Australian National University, Acton, Canberra, ACT 2601, Australia, ⁹⁶Graduate School for International Development and Cooperation, Hiroshima University, 1-5-1 Kagamiyama, Higashi-Hiroshima 739-8529, Japan, ⁹⁷Asian School of the Environment, Nanyang Technological University, Nanyang Avenue, Singapore, ⁹⁸International Peatland Society, Nisulankatu 78, 40720 Jyväskylä, Finland, ⁹⁹World Wide Fund for Nature, Simatupang Tower 2 Unit C 7 Floor Jl. Letjen TB. Simatupang Kav. 38, Jakarta Selatan 12540, Indonesia, ¹⁰⁰Faculty of Forestry, Bogor Agricultural University, Jl. Lingkar Akademik Kampus IPB, Dramaga, Bogor, Jawa Barat 16680, Indonesia, ¹⁰¹Grand Challenge Earth Lab, University of Colorado, 4001 Discover Drive Suite S348, Boulder, CO 80303, USA, ¹⁰²Queen Mary University of London, Mile End Rd, London E1 4NS, UK, ¹⁰³Land Surface Flux Measurements Group, Centre for Ecology and Hydrology, Maclean Building, Benson Lane, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB, UK, ¹⁰⁴Department of Aquatic Science, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia, ¹⁰⁵Centre for Remote Imaging, Sensing and Processing, National University of Singapore, 10 Lower Kent Ridge Road, Blk S17, Level 2, 119076, Singapore, ¹⁰⁶Geological Survey of Finland, P.O. Box 97 (Vaasantie 6), FI 67101 Kokkola, Finland, ¹⁰⁷Earthy Matters Environmental Consultants, Glenvar, Letterkenny, Co., Donegal, Ireland, ¹⁰⁸Research Centre for Biology, Indonesian Institute of Sciences (LIPI), Jl. Raya Jakarta – Bogor Km. 46 Cibinong, 16911 Bogor, Indonesia, ¹⁰⁹Department of Soil Science and Land Reclamation, Faculty of Environment and Agriculture, University of Warmia and Mazury, Michała Oczapowskiego 2, Olsztyn, Poland, ¹¹⁰Ecological Sciences Group, The James Hutton Institute, Craigiebuckler, Aberdeen, AB158QH Scotland, UK, ¹¹¹Department of Agriculture Technology, Faculty of Agriculture, Universiti Putra Malaysia, 43400 Serdang, Malaysia, ¹¹²Centre for Southeast Asian Studies, Kyoto University, 46 Shimoadachi-cho, Yoshida Sakyo-ku, Kyoto 606-8501, Japan, ¹¹³Southeast Asia Program, Research and Conservation Division, Copenhagen Zoo, Roskildevej 32, 2000 Frederiksberg, Denmark, ¹¹⁴Institute of Biodiversity and Environmental Conservation, Faculty of Resource Science and Technology, Universiti Malaysia Sarawak, 94300 Kota Samarahan, Sarawak, Malaysia, ¹¹⁵Environmental Research Institute, University of Highlands and Islands, Castle St., Thurso KW147JD, UK

The first International Peat Congress (IPC) held in the tropics – in Kuching (Malaysia) – brought together over 1000 international peatland scientists and industrial partners from across the world ('International Peat Congress with over 1000 participants!', 2016). The congress covered all aspects of peatland ecosystems and their management, with a strong focus on the environmental, societal and economic challenges associated with contemporary large-scale agricultural conversion of tropical peat.

However, recent encouraging developments towards better management of tropical peatlands have been undermined by misleading newspaper headlines and statements first published during the conference. Articles in leading regional newspapers ('Oil palm planting on peat soil handled well, says Uggah, 2016b; Cheng & Sibon, 2016; Nurbianto, 2016a,b; Wong, 2016) widely read across the region portrayed a general consensus, in summary of the conference, that current agricultural practices in peatland areas, such as oil palm plantations, do not have a negative impact on the environment. This view is not shared by many scientists or supported by the weight of evidence that business-as-usual management is not sustainable for tropical peatland agriculture.

Peer-reviewed scientific studies published over the last 19 years, as reflected in the Intergovernmental Panel on Climate Change (IPCC) Wetland Supplement on greenhouse gas inventories, affirm that drained tropical peatlands lose considerable amounts of carbon at high rates (Drösler *et al.*, 2014). Tropical peat swamp forests have sequestered carbon for millennia, storing a globally significant reservoir below ground in the peat (Page *et al.*, 2011; Dommain *et al.*, 2014). However, contemporary agriculture techniques on peatlands heavily impact this system through land clearance, drainage and fertilization, a process that too often involves fire. Along with biodiversity losses driven by deforestation (Koh *et al.*, 2011; Posa *et al.*, 2011; Giam *et al.*, 2012), the carbon stored in drained peatlands is rapidly lost through oxidation, dissolution and fire (Couwenberg *et al.*, 2009; Hirano *et al.*, 2012; Ramdani & Hino, 2013; Schrier-Uijl *et al.*, 2013; Carlson *et al.*, 2015; Warren *et al.*, 2016). Tropical peat fires are a major contributor to global greenhouse gas emissions and produce transboundary haze causing significant impacts on human health, regional economies and ecosystems (Page *et al.*, 2002; Marlier *et al.*, 2012; Jaafar & Loh, 2014; Chisholm *et al.*, 2016; Huijnen *et al.*, 2016; Stockwell *et al.*, 2016). With future El-Niño events predicted to increase in frequency and severity (Cai *et al.*, 2014) and with fire prevalence now decoupled from drought years (Gaveau *et al.*, 2014), future large-scale fire and haze events are imminent given the extensive areas of now-

drained fire-prone drained peatlands (Kettridge *et al.*, 2015; Turetsky *et al.*, 2015; Page & Hooijer, 2016).

In reality, just how much of the estimated 69 gigatonnes of carbon (Page *et al.*, 2011) stored in South-East Asian tropical peatlands is being lost due to agricultural operations under the current management regime is still uncertain. Of great concern is that none of the agricultural management methods applied to date have been shown to prevent the loss of peat and the associated subsidence of the peatland surface following drainage (Wösten *et al.*, 1997; Melling *et al.*, 2008; Hooijer *et al.*, 2012; Evers *et al.*, 2016). Recent projections suggest that large areas of currently drained coastal peatlands will become undrainable and progressively be subjected to longer periods of inundation by river and ultimately sea water (Hooijer *et al.*, 2015a,b; Sumarga *et al.*, 2016). With growing risk of saltwater intrusion, agriculture in these coastal lands will become increasingly untenable, calling into question the very notion of 'long-term sustainability of tropical peatland agriculture'.

A more accurate view of drained peatland agriculture is that of an extractive industry, in which a finite resource (the peat) is 'mined' to produce food, fibre and fuel, driven by global demand. In developing countries with growing populations, there are strong socio-economic arguments for exploiting this resource to support local livelihoods and broader economic development (Mizuno *et al.*, 2016). However, we must accept that ongoing peat loss is inevitable under this scenario. Science-based measures towards improved management, including limitations on the extent of plantation development, can be used to minimize the rate of this peat loss (President of Indonesia, 2011). Such an evidence-based position, supported with data and necessary legal instruments, is needed for sustainable futures. The scientifically unfounded belief that drained peatland agriculture can be made 'sustainable', and peat loss can be halted, via unproven methods such as peat compaction debilitates the effort to find sustainable possibilities. To a large extent, the issues surrounding unsustainable peatland management have now been recognized by sections of industry (Wilmar, 2013; APP, 2014; Cargill Inc., 2014; Mondelez International, 2014; Sime Darby Plantation, 2014; APRIL, 2015; Olam International, 2015), government (President of Indonesia, 2014, 2016, Mongabay, 2015; Mongabay Haze Beat, 2015; Hermansyah, 2016) and consumers (Wijedasa *et al.*, 2015). In recognition of the constraints and risks of peatland development, many large and experienced oil palm and pulpwood companies have halted further development on peat and introduced rigorous management requirements for existing peatland plantations (Lim *et al.*, 2012). However, the denial of the empirical basis calling for improved peatland management

remains persistent in influential policy spaces, as illustrated by the articles reporting on the conference ('Oil palm planting on peat soil handled well, says Uggah, 2016b; Cheng & Sibon, 2016; Nurbianto, 2016a,b).

The search for more responsible tropical peatland agriculture techniques includes promising recent initiatives to develop methods to cultivate crops on peat under wet conditions (Giesen, 2015; Dommain *et al.*, 2016; Mizuno *et al.*, 2016). While a truly sustainable peatland agriculture method does not yet exist, the scientific community and industry are collaborating in the search for solutions (International Peat Society, 2016), and for interim measures to mitigate ongoing rates of peat loss under existing plantations. Failing to recognize the devastating consequences of the current land use practices on peat soils and failing to work together to address them could mean that the next generation will have to deal with an irreversibly altered, dysfunctional landscape where neither environment nor society, globally or locally, will be winners.

Acknowledgements

Open access facilitated by Greifswald Mire Centre and Department of Forestry Sciences, University of Helsinki.

References

- APP (2014) APP Forest Conservation Policy Update 2014.
- APRIL (2015) APRIL Group's Sustainable Forest Management Policy 2.0. 1–4.
- Cai W, Borlace S, Lengaigne M *et al.* (2014) Increasing frequency of extreme El Niño events due to greenhouse warming. *Nature Climate Change*, **5**, 1–6.
- Cargill Inc. (2014) Cargill Policy on Sustainable Palm Oil.
- Carlson KM, Goodman LK, May-Tobin CC (2015) Modeling relationships between water table depth and peat soil carbon loss in Southeast Asian plantations. *Environmental Research Letters*, **10**, 74006.
- Cheng L, Sibon P (2016) Sarawak opening up coastal lowland areas for agriculture, plantation devt — Adenan. *BorneoPost*, Available at: <http://www.theborneopost.com/2016/08/17/sarawak-opening-up-coastal-lowland-areas-for-agriculture-plantation-devt-adenan/> (accessed 17 August 2016).
- Chisholm RA, Wijedasa LS, Swinfield T (2016) The need for long-term remedies for Indonesia's forest fires. *Conservation Biology*, **30**, 5–6.
- Couwenberg J, Dommain R, Joosten H (2009) Greenhouse gas fluxes from tropical peatlands in south-east Asia. *Global Change Biology*, **16**, 1715–1732.
- Dommain R, Couwenberg J, Glaser PH, Joosten H, Suryadiputra I, Nyoman N (2014) Carbon storage and release in Indonesian peatlands since the last deglaciation. *Quaternary Science Reviews*, **97**, 1–32.
- Dommain R, Dittich I, Giesen W, Joosten H, Rais DS, Silvius M, Wibisono ITC (2016) Ecosystem services, degradation and restoration of peat swamps in the Southeast Asian tropics. In: *Peatland Restoration and Ecosystem Services: Science, Policy and Practice* (eds Bonn A, Allott T, Evans M, Stoneman R, Joosten H). Cambridge University Press, Cambridge.
- Drüser M, Verchot LV, Freibauer A *et al.* (2014) Chapter 2: Drained inland organic soils. In: *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands* (eds Hiraishi T, Krug T, Tanabe K, Srivastava N, Jamsranjav B, Fukuda M, Troxler T), pp. 1–79. IPCC, Switzerland.
- Evers S, Yule C, Padfield R, O'Reilly P, Varkkey H (2016) Keep Wetlands Wet: The Myth of Sustainable Development of Tropical Peatlands - Implications for Policies and Management. *Global Change Biology*, 1–16, doi:10.1111/gcb.13422/abstract
- Gaveau DLA, Salim M, Hergoualc'h K *et al.* (2014) Major atmospheric emissions from peat fires in Southeast Asia during non-drought years: evidence from the 2013 Sumatran fires. *Scientific reports*, **4**, 1–7.
- Giam X, Koh LP, Tan HH, Miettinen J, Tan HTW, Ng PKL (2012) Global extinctions of freshwater fishes follow peatland conversion in Sundaland. *Frontiers in Ecology and the Environment*, **10**, 465–470.
- Giesen W (2015) Utilising non-timber forest products to conserve Indonesia's peat swamp forests and reduce carbon emissions. *Journal of Indonesian Natural History*, **3**, 10–19.
- Hermansyah A (2016) Soil compaction puts peatland at risk, agency says. *The Jakarta Post*, Available at: <http://www.thejakartapost.com/news/2016/03/08/soil-compaction-puts-peatland-risk-agency-says.html> (accessed 8 March 2016).
- Hirano T, Segah H, Kusin K, Limin S, Takahashi H, Osaki M (2012) Effects of disturbances on the carbon balance of tropical peat swamp forests. *Global Change Biology*, **18**, 3410–3422.
- Hooijer A, Page S, Jauhiainen J, Lee WA, Lu XX, Idris A, Anshari G (2012) Subsidence and carbon loss in drained tropical peatlands. *Biogeosciences*, **9**, 1053–1071.
- Hooijer A, Vernimmen R, Visser M, Mawdsley N (2015a) Flooding projections from elevation and subsidence models for oil palm plantations in the Rajang Delta peatlands, Sarawak, Malaysia. *Deltares report 1207384*, 76 pp.
- Hooijer A, Vernimmen R, Mawdsley N, Page S, Mulyadi D, Visser M (2015b) *Assessment of Impacts of Plantation Drainage on the Kampar Peninsula Peatland*. Deltares Report, Riau. 1207384.
- Huijnen V, Wooster MJ, Kaiser JW *et al.* (2016) Fire carbon emissions over maritime southeast Asia in 2015 largest since 1997. *Scientific Reports*, **6**, 26886.
- International Peat Congress with over 1000 participants! (2016a) PeatNews.
- International Peat Society (2016) Statement regarding the Jakarta Post article of 18th August.
- Jaafar Z, Loh TL (2014) Linking land, air and sea: Potential impacts of biomass burning and the resultant haze on marine ecosystems of Southeast Asia. *Global Change Biology*, **20**, 2701–2707.
- Kettridge N, Turetsky MR, Sherwood JH *et al.* (2015) Moderate drop in water table increases peatland vulnerability to post-fire regime shift. *Scientific Reports*, **5**, 8063.
- Koh LP, Miettinen J, Liew SC, Ghazoul J (2011) Remotely sensed evidence of tropical peatland conversion to oil palm. *Proceedings of the National Academy of Sciences of the United States of America*, **108**, 5127–5132.
- Lim KH, Lim SS, Parish F, Suharto R (2012) *RSPO Manual on Best Management Practices (BMPs) for Existing Oil Palm Cultivation on Peat*. RSPO, Kuala Lumpur, Malaysia. 214 pp.
- Marlier ME, DeFries RS, Voulgarakis A *et al.* (2012) El Niño and health risks from landscape fire emissions in southeast Asia. *Nature Climate Change*, **3**, 131–136.
- Melling L, Goh KJ, Beauvais C, Hatano R (2008) Carbon Flow and Budget in Young Mature Oil Palm Agroecosystem on Deep Tropical Peat. *Planter*, **84**, 21.
- Mizuno K, Fujita MS, Kawai S (2016) *Catastrophe & Regeneration in Indonesia's Peatlands: Ecology, Economy & Society* (eds Mizuno K, Fujita MS, Kawai S). NUS Press, Singapore, 466 pp.
- Mondelez International (2014) Mondelez International Palm Oil Action Plan.
- Mongabay (2015) Jokowi to oversee Indonesia peat restoration agency but details thin on the ground. Mongabay.
- Mongabay Haze Beat (2015) Jokowi pledges Indonesia peatland "revitalization" to stop the burning. Mongabay.
- Nurbianto B (2016a) Congress may change views on cultivation of peatland: IPS. *The Jakarta Post*, Available at: <http://www.thejakartapost.com/news/2016/08/18/congress-may-change-views-on-cultivation-of-peatland-ips.html> (accessed 18 August 2016).
- Nurbianto B (2016b) Malaysia challenges the world over palm oil on peatland. *The Jakarta Post*, Available at: <http://www.thejakartapost.com/news/2016/08/24/malaysia-challenges-the-world-over-palm-oil-on-peatland.html> (accessed 24 August 2016).
- Oil palm planting on peat soil handled well, says Uggah (2016b) BorneoPost. Available at: <http://www.theborneopost.com/2016/08/19/oil-palm-planting-on-peat-soil-handled-well-says-uggah/> (accessed 19 August 2016).
- Page SE, Hooijer A (2016) In the line of fire: the peatlands of Southeast Asia. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences*, **371**, 20150176.
- Page SE, Siegert F, Rieley JO, Boehm HV (2002) The amount of carbon released from peat and forest fires in Indonesia during 1997. *Nature*, **1999**, 61–65.
- Page SE, Rieley JO, Banks CJ (2011) Global and regional importance of the tropical peatland carbon pool. *Global Change Biology*, **17**, 798–818.
- Posa MRC, Wijedasa LS, Corlett RT (2011) Biodiversity and conservation of tropical peat swamp forests. *BioScience*, **61**, 49–57.
- President of Indonesia (2011) Instruction of the President of the Republic of Indonesia number 10 of 2011 about suspension of granting of new licenses and improvement of governance of natural primary forest and peatland.

- President of Indonesia (2014) Government Regulation Number 71 of year 2014 about Protection and Management of Peat Ecosystems.
- President of Indonesia (2016) Presidential Regulation Number 1 of year 2016 About Peat Restoration Agency.
- Ramdani F, Hino M (2013) Land Use Changes and GHG Emissions from Tropical Forest Conversion by Oil Palm Plantations in Riau Province, Indonesia. *PLoS ONE*, **8**, 1–6.
- Schrier-Uijl AP, Silvius M, Parish F, Lim KHH, Rosediana S, Anshari G (2013) *Environmental and Social Impacts of Oil Palm Cultivation on Tropical Peat: a Scientific Review*, pp. 131–168. Roundtable of Sustainable Palm Oil, Kuala Lumpur, Malaysia.
- Sime Darby Plantation (2014) Sustainability: Peatland planting policy.
- Stockwell CE, Jayarathne T, Cochrane MA *et al.* (2016) Field measurements of trace gases and aerosols emitted by peat fires in Central Kalimantan, Indonesia during the 2015 El Niño. *Atmospheric Chemistry and Physics Discussions*, **53**, 1–37.
- Sumarga E, Hein L, Hooijer A, Vernimmen R (2016) Hydrological and economic effects of oil palm cultivation in Indonesian peatlands. *Ecology and Society*, **21**, 52.
- Turetsky MR, Benscoter B, Page S, Rein G, Van Der Werf GR, Watts A (2015) Global vulnerability of peatlands to fire and carbon loss. *Nature Geoscience*, **8**, 11–14.
- Warren M, Froking S, Dai Z, Kurnianto S (2016) Impacts of land use, restoration, and climate change on tropical peat carbon stocks in the twenty-first century: implications for climate mitigation. *Mitigation and Adaptation Strategies for Global Change*, doi:10.1007/s11027-016-9712-1.
- Wijedasa LS, Posa MRC, Clements GR (2015) Peat fires: consumers to help beat them out. *Nature*, **527**, 305.
- Wilmar International (2013) *No Deforestation*, pp. 1–9. No Peat, No Exploitation Policy.
- Wong J (2016) Yield of oil palm on peatland can be doubled. The Star.
- Wösten JHM, Ismail AB, Van Wijk ALM (1997) Peat subsidence and its practical implications: A case study in Malaysia. *Geoderma*, **78**, 25–36.